SECTION 03300

REINFORCED CONCRETE

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LANL MASTER CONSTRUCTION SPECIFICATION

TO BE USED WITHOUT SECTIONS 03100 AND 03200

This section applies to structural concrete for buildings that are designed in accordance with ACI 318, non-nuclear facilities classified as Performance Category (PC) 1 or 2 facilities. This section does not apply to nuclear facilities.

When editing to suit project, author shall add job-specific requirements and delete only those portions that in no way apply to the activity (e.g., a component that does not apply). To seek a variance from applicable requirements, contact the LEM Structural POC.

When assembling a specification package, include applicable specifications from all Divisions, especially Division 1, General Requirements.

Delete information within "stars" during editing.

Specification developed for ML-3 projects. For ML-1 / ML-2, additional requirements and QA reviews are required.

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PART 1 GENERAL

1.1 SECTION INCLUDES

A. Formwork, shoring, bracing, and anchorage.

B. Concrete reinforcing and accessories.

C. Cast-in-place concrete.

D. Control, expansion, and contraction joint devices associated with concrete work.

1.2 SUBMITTALS

A. Submit the following in accordance with Section 01330, Submittal Procedures:

B. Concrete design mixes.

1. Submit separate mix design for:

a. Each concrete strength.

b. Each range of air content.

c. Each nominal maximum aggregate size.

d. Concrete to be pumped.

e. Concrete with identifiable admixtures.

2. Include the following information with each design:

a. Quantity of water.

b. Type, brand, certification, and quantity of cement.

c. Source, certification, and quantity of each nominal maximum size of aggregate.

d. Type, brand, sources, certification and quantity of admixture, if used.

e. Type, source, certification and quantity of fly ash, if used.

f. Water/cement ratio.

g. Air-content.

h. Slump

i. Strength test record, in accordance with ACI 301.

C. Batch Tickets

1. Submit 2 legible copies of the batch ticket for each load of concrete to the LANL Construction Inspector.

2. Conform to the requirements for batch tickets in accordance with ASTM C94. Include the following information:

a. Name of ready-mix batch plant.

b. Serial number of ticket.

c. Date.

d. Truck number.

e. Name of purchaser.

f. Specific designation of job (name and location).

g. Specific class or designation of the concrete in conformance with that employed in job specifications.

h. Amount of concrete in cubic yards (or cubic meters).

i. Time loaded or of first mixing of cement and aggregates.

j. Water added by receiver of concrete and his initials.

k. Reading of revolution counter at the first addition of water.

l. Type and brand, and amount of cement.

m. Type and brand, and amount of admixtures

n. Information necessary to calculate the total mixing water added by the producer. Total mixing water includes free water on the aggregates, water, and ice batched at the plant, and water added by the truck operator from the mixer tank.

o. Maximum size of aggregate.

p. Weights of fine and coarse aggregate.

q. Ingredients certified as being previously approved.

r. Signature or initials of ready-mix representative.

3. Record on each, the location where placed in structure and time of placement.

D. Shop Drawings: Indicate bar sizes, spacing, locations and quantities of reinforcing steel and welded wire fabric, bending and cutting schedules, supporting and spacing devices.

E. Catalog Data: Provide data on joint devices, attachment accessories, and admixtures.

F. Test reports of concrete field testing per PART 3, Field Quality Control.

1.3 QUALITY ASSURANCE

A. Perform Work in accordance with ACI 301, 318, and 347.

B. Acquire cement from same source for all work.

C. Acquire aggregate from same source for all work.

D. Conform to ACI 305R when concreting during hot weather.

E. Conform to ACI 306R when concreting during cold weather.

PART 2 PRODUCTS

2.1 WOOD FORM MATERIALS AND ACCESSORIES

A. Softwood Plywood: PS 1, C Plugged Grade, Group 2.

B. Form Ties: Snap off type, galvanized metal cone type with waterproofing washer free of defects that could leave holes larger than 1 in. in concrete surface.

C. Form Release Agent: Colorless mineral oil which will not stain concrete, absorb moisture, or impair natural bonding or color characteristics of coating intended for use on concrete.

2.2 REINFORCING AND ACCESSORIES

A. Reinforcing Steel: ASTM A 615, grade 60 deformed bars; ties and stirrups, grade 40.

B. Welded Steel Wire Fabric: ASTM A 185 Plain type in flat sheets.

C. Chairs, Bolsters, Bar Supports, Spacers: Size and shape for strength and support of reinforcement during concrete placement conditions including load bearing pad on bottom to prevent vapor barrier puncture. Special chairs, bolsters, bar supports, spacers adjacent to weather exposed concrete surfaces to be plastic coated steel type; size and shape as required.

2.3 CONCRETE MATERIALS

A. Cement: ASTM C150, Type I or Type II.

B. Fine and Coarse Aggregates: Conform to ASTM C33.

C. Water: Potable water that is clean and not detrimental to concrete.

2.4 ADMIXTURES

A. Air Entrainment: Conform to ASTM C260.

B. Chemical: Conform to ASTM C494.

C. [Fly Ash: Conform to ASTM C618, type F].

2.5 ACCESSORIES

A. Bonding Agent: Polymer resin emulsion.

B. Vapor Barrier: 6 mil clear polyethylene film, of type recommended for below grade application.

C. Non-Shrink Grout: Premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents; capable of developing minimum compressive strength of 2,400 psi in 48 hours and 7,000 psi in 28 days.

D. Joint Filler: ASTM D1751; asphalt impregnated fiberboard or felt, 1/4 in. thick.

2.6 CONCRETE MIX

A. Mix and deliver concrete in accordance with ASTM C94.

B. Select proportions for normal weight concrete in accordance with ACI 301, proportioning on the basis of previous field experience or trial mixtures method, for f_{cr} = the larger of:

$f_{cr} \geq f'_c + 1.34s$, or

$f_{cr} \geq f'_c + 2.33s - 500$, where:

f_{cr} = required average compressive strength of concrete mix design, psi

f'_c = specified design compressive strength of concrete, psi

s = standard deviation, psi

If a suitable record of tests is not available to establish a standard deviation, use the following:

$f_{cr} \geq f'_c + n$, where:

n = additional required strength, psi, for a specified f'_c:

n = 1000 psi for f'_c = less than 3000 psi.
n = 1200 psi for f'_c = 3000 to 5000 psi.
n = 1400 psi for f'_c = over 5000 psi.

C. Provide concrete meeting the following criteria:

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The Structural Engineer shall specify the required 28 day concrete strength f'_c in accordance with the Structural Standards.
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1. Exterior concrete exposed to freezing and thawing.

   a. Compressive strength, f'_c: [4,000 psi @ 28 days].

   b. Maximum nominal aggregate size: [0.75 in.]

   c. Maximum water / cement ratio: [0.44].

   d. Slump: [3 in. plus or minus 1 in. tolerance].

e. Air content: [4 to 6] percent.

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Caution - 5000 psi concrete is prone to hairline cracking.

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2. Exterior concrete exposed to freezing and thawing.

   a. Compressive strength, f'_c: [5000 psi, at 28 days].

   b. Maximum nominal aggregate size: [0.75 inch].

   c. Maximum water/cement ration: 0.34.

   d. Slump: [3 inches plus or minus 1 inch tolerance].

   e. Air Content: [4 to 6] percent.

3. Interior concrete not exposed to freezing and thawing.

   a. Compressive strength, f'_c: [4,000 psi at 28 days].

   b. Maximum nominal aggregate size: [0.75 inch]

   c. Maximum water/cement ratio: [0.44].

   d. Slump: [3 in. plus or minus 1 inch tolerance.]

   e. Air content: [2 to 4] percent.

4. Interior concrete not requiring air entraining agent.

   a. Compressive strength, f'_c: [5000 psi, @ 28 days.]

   b. Maximum nominal aggregate size: [0.75 in.]

   c. Maximum water/cement ratio: 0.34.

   d. Slump: [3 in. plus or minus 1 inch tolerance].

   e. Air Content: [0 to 2] percent.

D. Use accelerating admixtures in cold weather only when approved by the LANL Construction Inspector. Use of admixtures will not relax cold weather placement requirements.

E. Do not use calcium chloride as an admixture.

F. Use set retarding admixtures during hot weather only when approved by the LANL Construction Inspector.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify lines, levels, and centers before proceeding with formwork. Ensure that dimensions agree with the Drawings.

B. Verify that anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed, positioned securely, and will not cause hardship in placing concrete.

3.2 FORMWORK ERECTION

A. Hand trim sides and bottom of earth forms. Remove loose soil prior to placing concrete.

B. Erect formwork, shoring and bracing to achieve design requirements, in accordance with requirements of ACI 301.

C. Provide bracing to ensure stability of formwork. Shore or strengthen formwork subject to overstressing by construction loads.

D. Arrange and assemble formwork to permit dismantling, stripping and removal of remaining principal shores. Do not damage concrete during stripping.

E. Align joints and make watertight. Keep form joints to a minimum.

F. Obtain approval from the LANL Construction Inspector before framing openings (in structural members) which are not detailed on Drawings.

G. Provide chamfer strips on external corners of beams, joists, columns, and walls.

H. Apply form release agent prior to placement of reinforcing steel, anchoring devices, and embedded items.

I. Do not apply form release agent where concrete surfaces receive special finishes or applied coverings which are effected by agent. Soak inside surfaces of untreated forms with clean water. Keep surfaces coated prior to placement of concrete.

J. Provide formed openings where required for items to be embedded in or passing through concrete work.

K. Locate and set in place items which cast directly into concrete.

L. Clean formed cavities of debris prior to placing concrete.

M. During cold weather, remove ice and snow from within forms. Do not use deicing salts or water to clean out forms. Use compressed air or other means to remove foreign matter.

N. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and other imposed loads without excessive deflection or creep.

3.3 REINFORCING PLACEMENT

A. Place, support and secure reinforcement against displacement. Do not deviate from required position.

B. Do not displace or damage vapor barrier.

C. Maintain concrete cover around reinforcing as follows:

Item	Minimum cover, in.
1. Concrete cast against and permanently exposed to earth:	3
2. Concrete exposed to earth or weather:	
#6 through #18 bars	2
#5 bar, W31 or D31 wire, and smaller	1-1/2
3. Concrete not exposed to weather or in contact with ground:	
Slabs, walls, joists: #11 bar and smaller	3/4
4. Beams, columns:	
Primary reinforcement, ties, stirrups, spirals:	1-1/2

3.4 PREPARATION

A. Prepare previously placed concrete by cleaning with steel brush and applying bonding agent in accordance with manufacturer's instructions.

B. [In locations where new concrete is to be dowelled to existing work, drill holes in existing concrete, insert steel dowels and pack solid with non-shrink grout.]

3.5 PLACING CONCRETE

A. Place concrete in accordance with ACI 301.

B. Notify the LANL Construction Inspector a minimum of 24 hours prior to commencement of concreting operations.

C. Ensure that reinforcement, inserts, embedded parts, formed joint fillers, joint devices, and formwork are not disturbed during concrete placement.

D. Install vapor barrier under interior slabs on grade. Lap joints minimum 6 in. and seal watertight by sealant applied between overlapping edges and ends or taping edges and ends.

E. Repair vapor barrier damaged during placement of concrete reinforcing.

F. Place concrete continuously between predetermined expansion, control, and construction joints.

G. Screed floors and slabs on grade level, maintaining surface flatness of maximum 1/4 in. in 10 ft.

3.6 CONCRETE FINISHING

A. Provide formed concrete surfaces to be left exposed with smooth rubbed finish.

B. Finish concrete floor surfaces in accordance with ACI 301.

C. Wood float surfaces which will receive tile with full bed setting system.

D. Steel trowel surfaces which will receive carpeting, resilient flooring, seamless flooring, or thin set tile.

E. Steel trowel surfaces which are scheduled to be exposed.

F. Provide a broom finish on exterior sidewalks and paving.

G. In areas with floor drains, maintain floor elevation at walls; pitch surfaces uniformly to drains at 1/8 in. per foot, minimum.

3.7 CURING AND PROTECTION

A. Immediately after placement, protect concrete from pre-mature drying, excessively hot or cold temperatures, and mechanical injury.

B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for complete hydration of cement and hardening of concrete.

C. Cure floor surfaces in accordance with ACI 308.

3.8 FIELD QUALITY CONTROL

A. Provide a certified testing agency to perform field testing in accordance with ACI 301

B. Submit proposed mix design of each class of concrete to the LANL Construction Inspector for approval prior to commencement of work.

C. Inform the LANL Construction Inspector 48 hours in advance of field testing to allow for witnessing of testing.

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The Structural Engineer shall determine the frequency and type of field and laboratory testing. The batch plant that supplies concrete to LANL currently produces concrete with a standard deviation of 700 psi for 4000 psi air entrained concrete.
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D. The Testing Agency shall perform the following tests and collect strength cylinders on one batch in every 50 cu. yds. of concrete placed or once a day when less than 50 cu. yds. is placed.

1. Record temperature of concrete in accordance with ASTM C1064.

2. Perform slump test in accordance with ASTM C143.

3. Perform air content test in accordance with ASTM C231, pressure method.

4. Take 4 concrete strength test cylinders in accordance with ASTM C31.

E. The Testing Agency shall test the strength test cylinders in accordance with ASTM C39 at 7 days and 28 days.

3.9 CONCRETE ACCEPTANCE CRITERIA

A. Fresh Concrete

1. Temperature - Less than 90 degrees F.

2. Slump - per Section 2.6.

3. Air content - per Section 2.6.

4. Drum revolution counter - 100 to 300 revolutions within 1-1/2 hours after initial mixing.

B. Strength

1. Concrete strength is satisfactory if the average of all sets of 3 consecutive strength test results equal or exceed the specified 28 day strength f'_c and no individual strength test result falls below the specified 28 day strength f'_c by more than 500 psi.

C. Appearance

1. Free from honeycombs and embedded debris.

D. Construction requirements

1. Conforming to required lines, details, dimensions and tolerances specified for construction.

3.10 DEFECTIVE CONCRETE

A. Defective concrete is concrete not conforming to acceptance criteria in Section 3.9.

B. Do not accept or place defective concrete that is not in conformance with acceptance criteria. Return the fresh concrete to the supplier.

C. Replace defective concrete not meeting strength criteria, at Contractor's expense. The Contractor may, at its expense, evaluate the concrete's in-place strength by testing 3 core samples for each strength test where LANL cured cylinders where more than 500 psi below f'_c in accordance with ACI 301 and ASTM C42. Fill core holes in accordance with ACI 301.

D. Replace defective concrete not meeting appearance criteria, at Contractor's expense. The Contract Administrator may allow repair of defective concrete at Contractor's expense.

E. Replace concrete not in conformance with details, tolerances, and other construction requirements at Contractor's expense.

END OF SECTION

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Do not delete the following reference information:
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FOR LANL USE ONLY

This project specification is based on LANL Master Construction Specification Rev. 3, dated August 30, 2002.